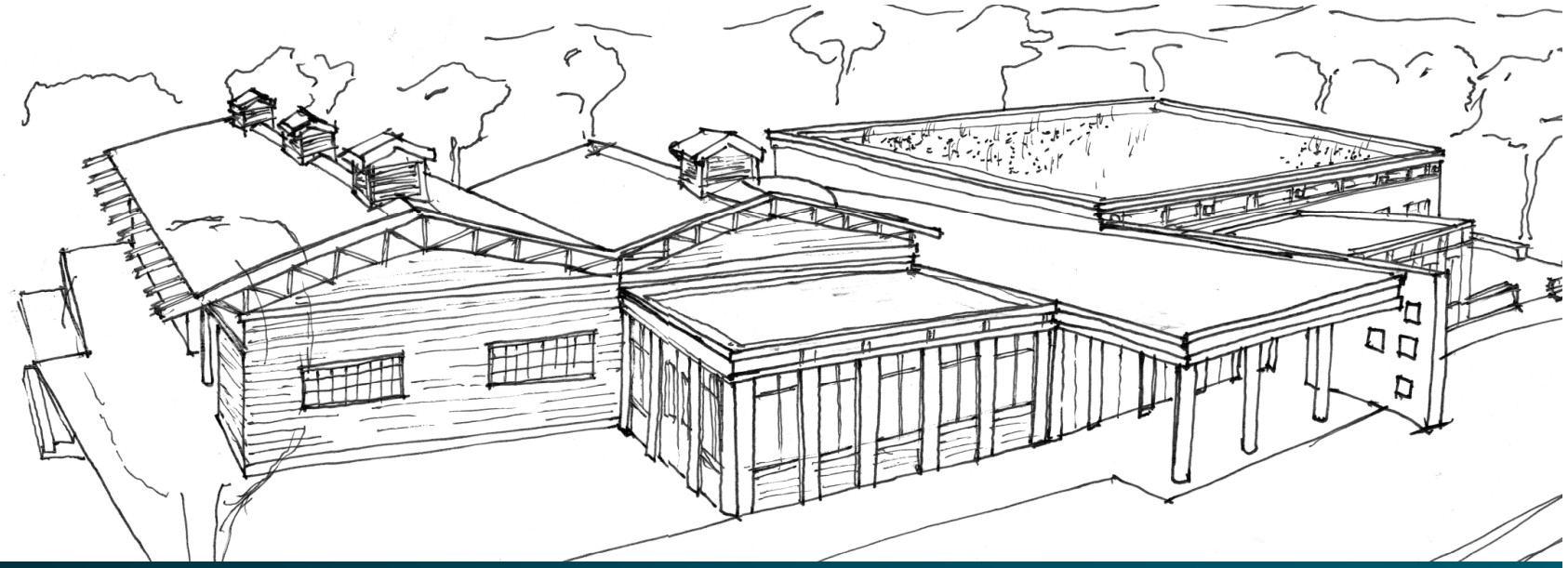

The Scales of Sustainable Design In Developing Nations

Sean Quinn, MSSD, LEED AP
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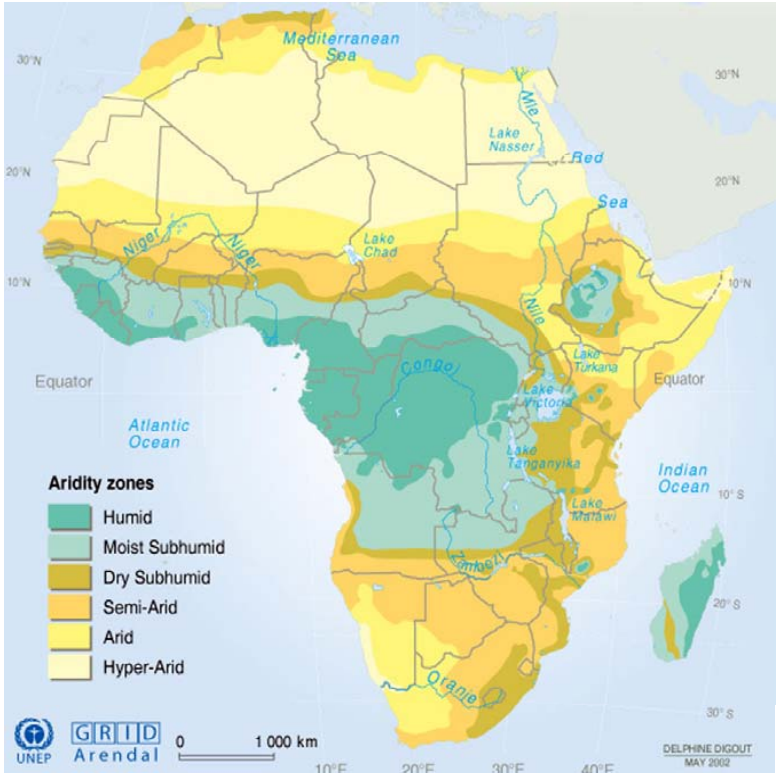
AGENDA

- **Impact of Climate Change in Africa**
- **Impact of Climate Change in Rwanda**
- **Renewable Energy Resources**
- **Akilah Institute – Phase I Design**
- **Akilah Institute – Phase II Design**

PURPOSE & OBJECTIVES

- **To investigate the means by which built-environment professionals can mitigate the effects of climate change and natural disaster.**
- **To respond to an equatorial climate with high temperatures, sporadic rain fall, and increased seismic activity.**
- **To provide access to clean energy, water, and food.**
- **To improve community knowledge and capacity of local resources through the introduction of sustainable building methods and renewable energy technologies.**
- **To work with local organizations and other relief agents to develop solutions to create sustainable communities and stimulate market development.**

Impacts And Vulnerabilities Associated With Climate Change In Africa



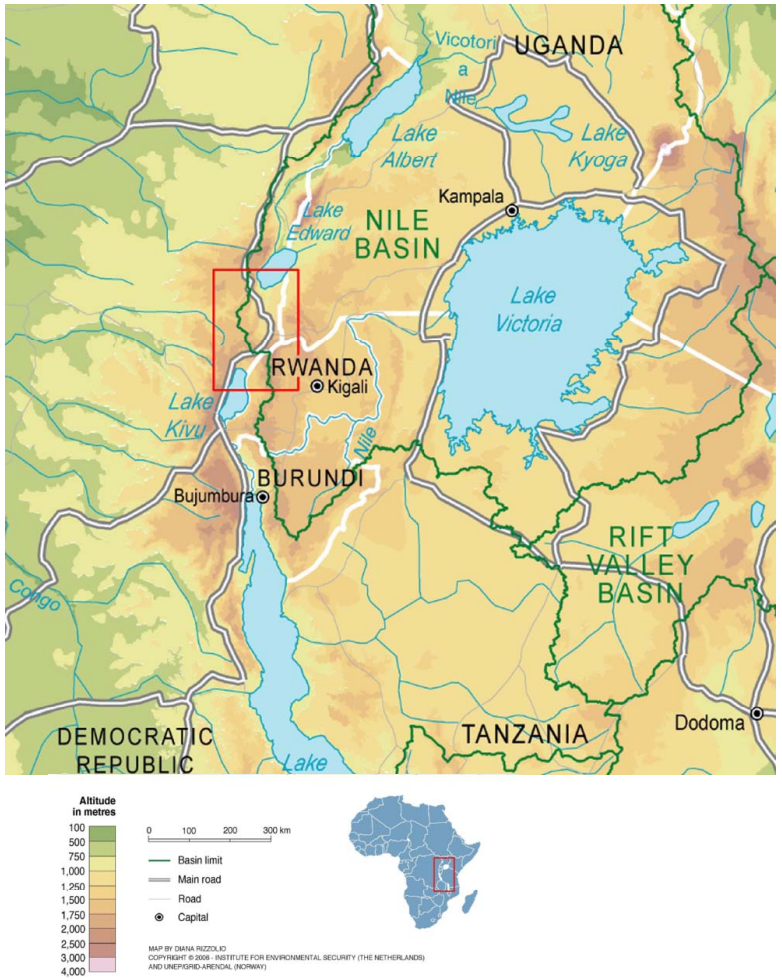
Source (L): World Meteorological Organization (WMO), United Nation Environment Programme (UNEP), *Climate Change 2001: Impacts, Adaptation and Vulnerability.* Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

Source (R): Adapted from: Boko, M., I. Niang, A. Nyong, C. Vogel, A. Githeko, M. Medany, B. Osman-Elasha, R. Tabo and P. Yanda, 2007: Africa. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof,* P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge UK, 433-467.

IMPACT OF CLIMATE CHANGE IN AFRICA

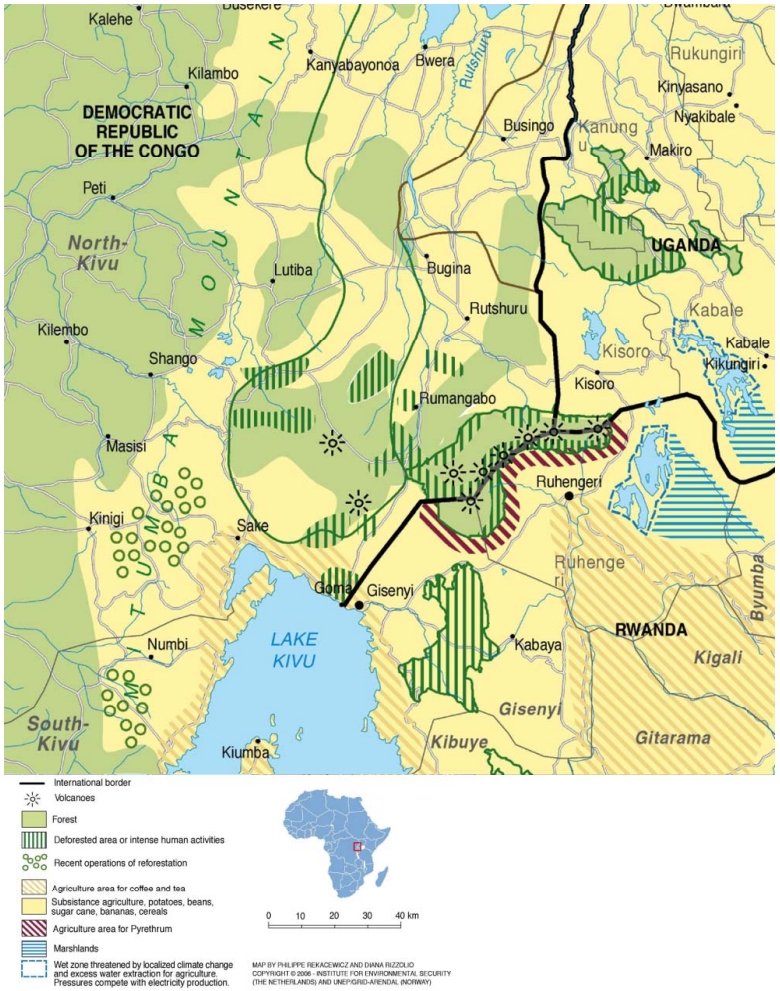
Population Movements & Environmental Pressures

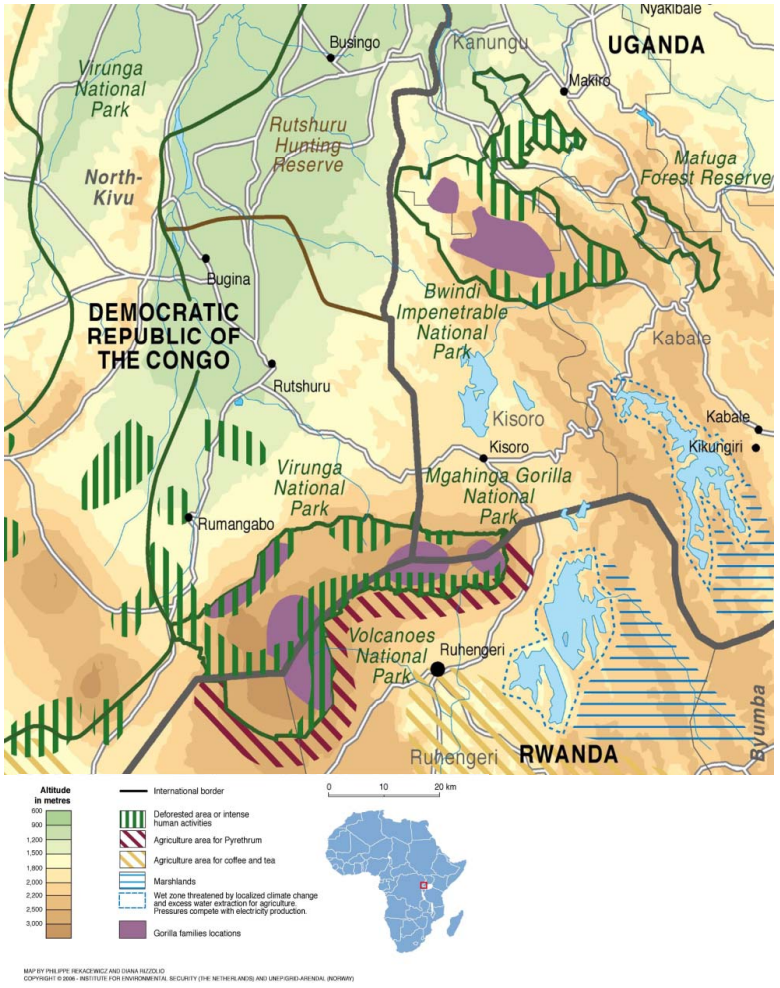
Water Basins



Source: Institute for Environmental Security (IES) Field Survey; United Nations High Commissioner for Regugees (UNHCR); *International Campaign to Ban Landmines (ICBL),* www.ibcl.org/lm; Spatial data produced by FAO Africover

Land Use and Cover

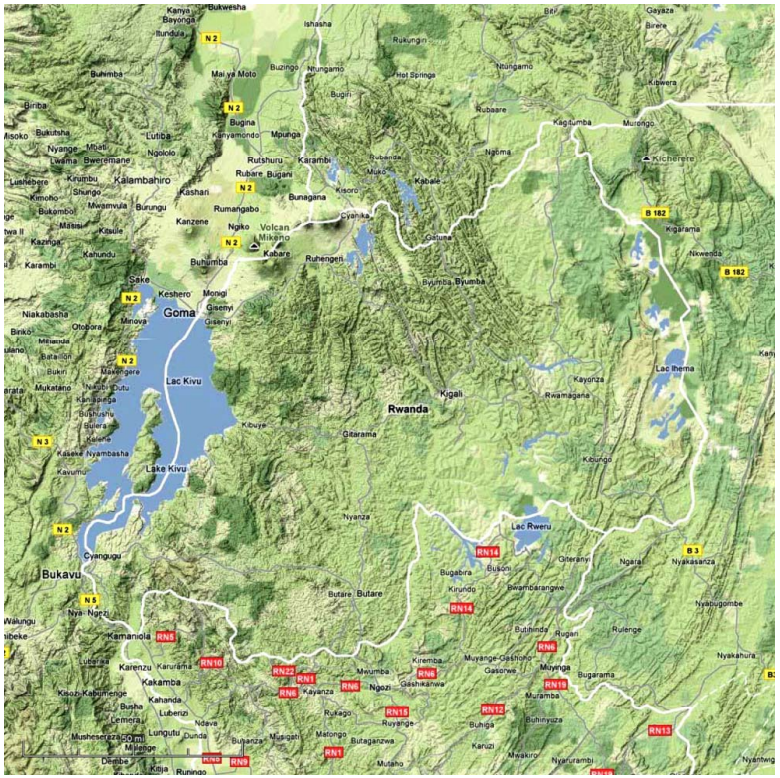


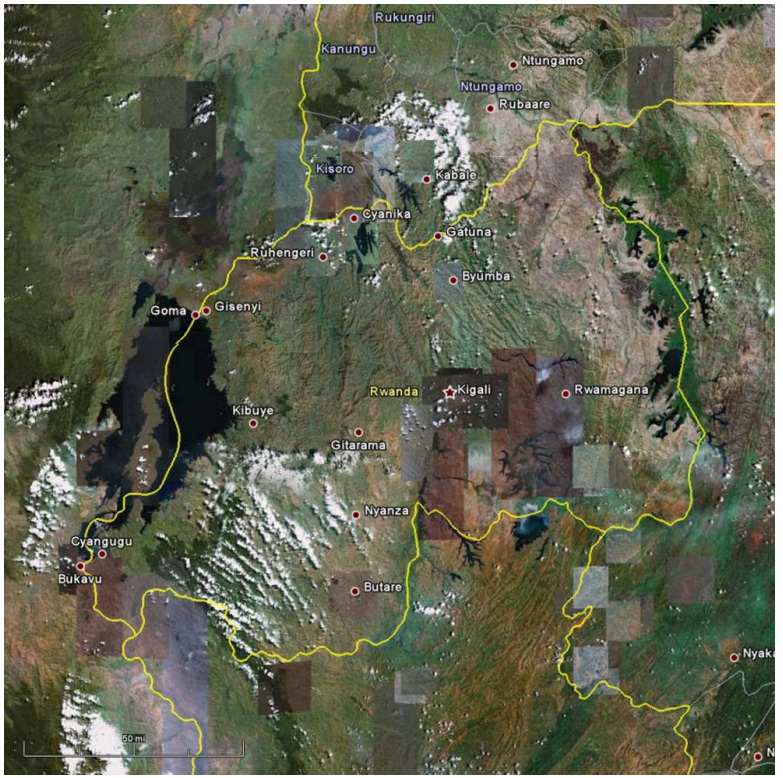


Source: Institute for Environmental Security (IES) Field Survey; United Nations High Commissioner for Regugees (UNHCR); *International Campaign to Ban Landmines (ICBL),* www.ibcl.org/lm; Spatial data produced by FAO Africover

IMPACT OF CLIMATE CHANGE IN RWANDA

Overview





Source: Google Earth

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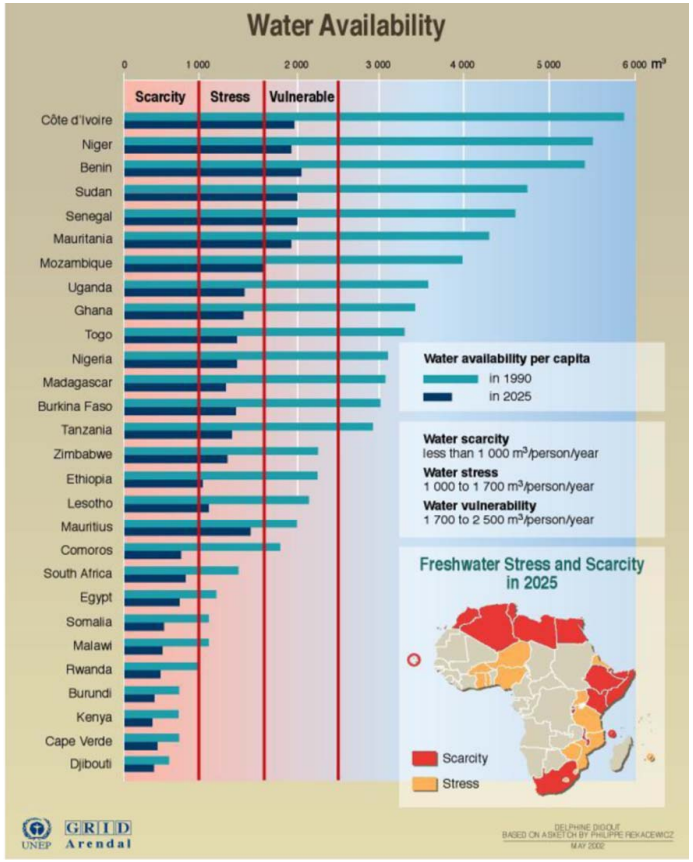
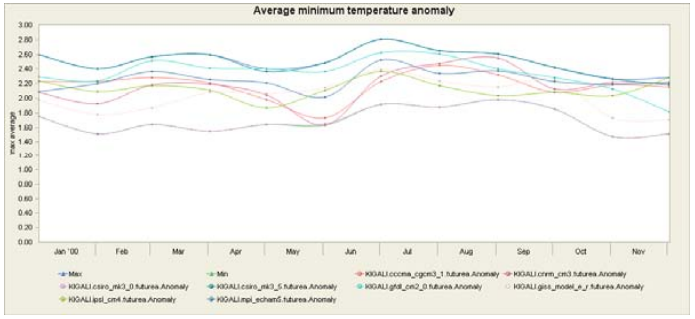
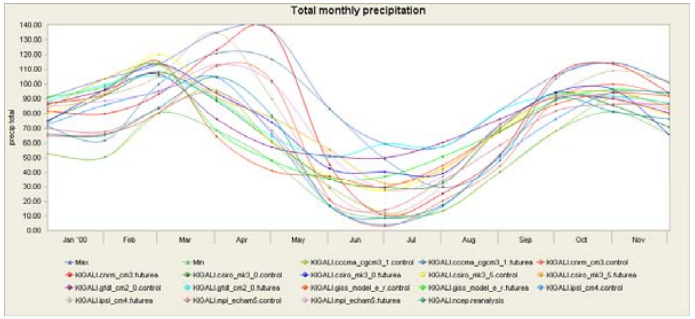
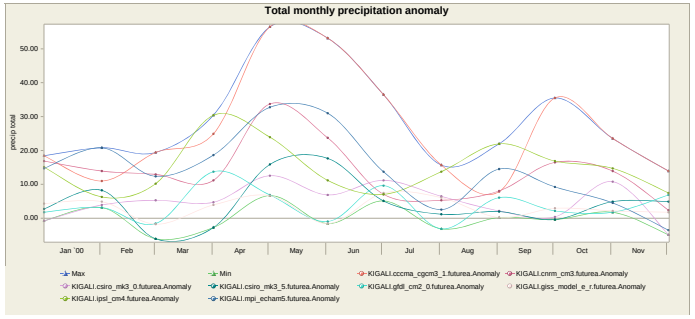
Current and Possible Future Variations in Temperature and Precipitation in Rwanda









Source (L): United Nations Economic Commission for Africa (UNECA), Addis Ababa; Global Environment Outlook 2000 (GEO), UNEP, Earthscan, London, 1999.

Source (R): Watkiss, Paul; Jane Olwoch, Tom Downing, Jillian Dyszynski. *Economic Impacts of Climate Change in Rwanda*. Department for International Development; DEW Point; Stockholm Environmental Institute. 23 February 2009.

IMPACT OF CLIMATE CHANGE IN RWANDA

Current Impacts and Vulnerabilities Associated with Climate Change in Rwanda


City Impressions of the Street in Kigali, Rwanda


Unpaved Streets within the Urban Area


Rusumo Falls before Rugezi's Degradation, 2000


Rusumo Falls after Rugezi's Degradation, 2005


Crop Failure due to Draught (2005, East Province)


Crop failure due to Floods (2007, West Province)


Destruction of Property (2006, North Province)

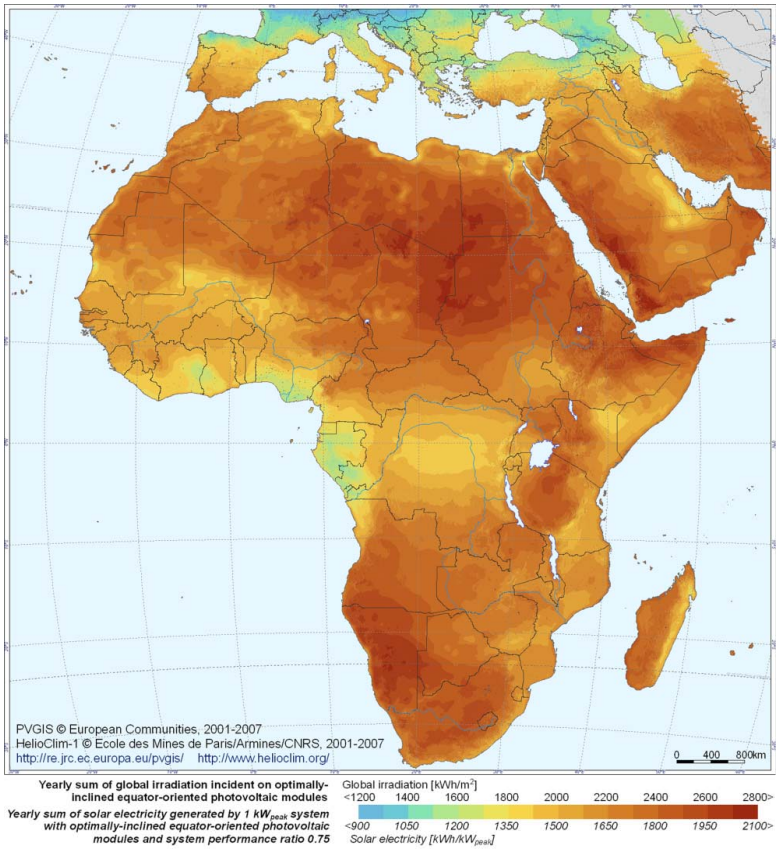

Destruction of Property (2007, West Province)

Source: Henninger, Sasch. *Urban Climate and Air Pollution in Kigali, Rwanda.* The Seventh International Conference on Urban Climate. 29 June – 3 July 2009, Yokohama, Japan.

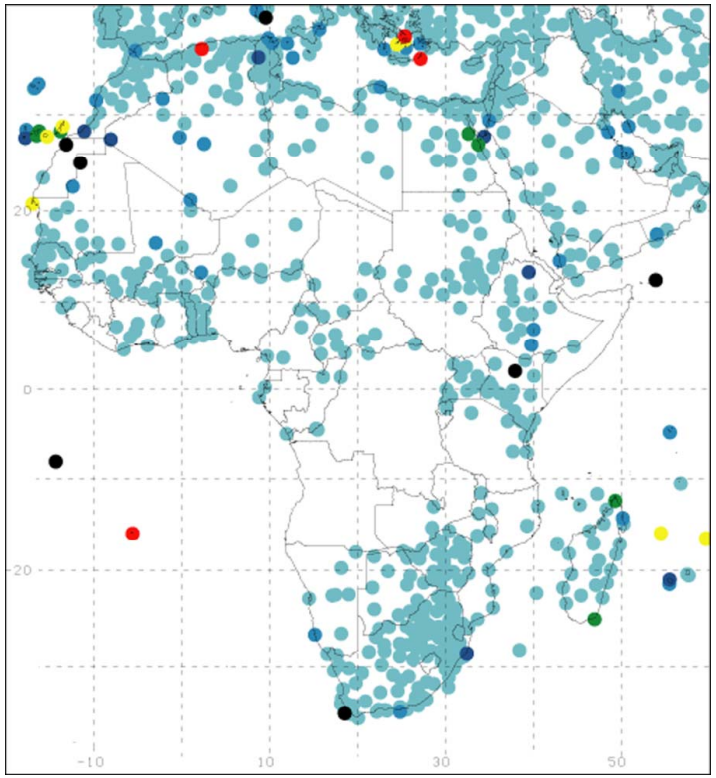
Source: Dr Rose Mukankomeje. Impact of Climate Change in Rwanda. 2009.

RENEWABLE ENERGY RESOURCES

Solar Energy Potential in Africa



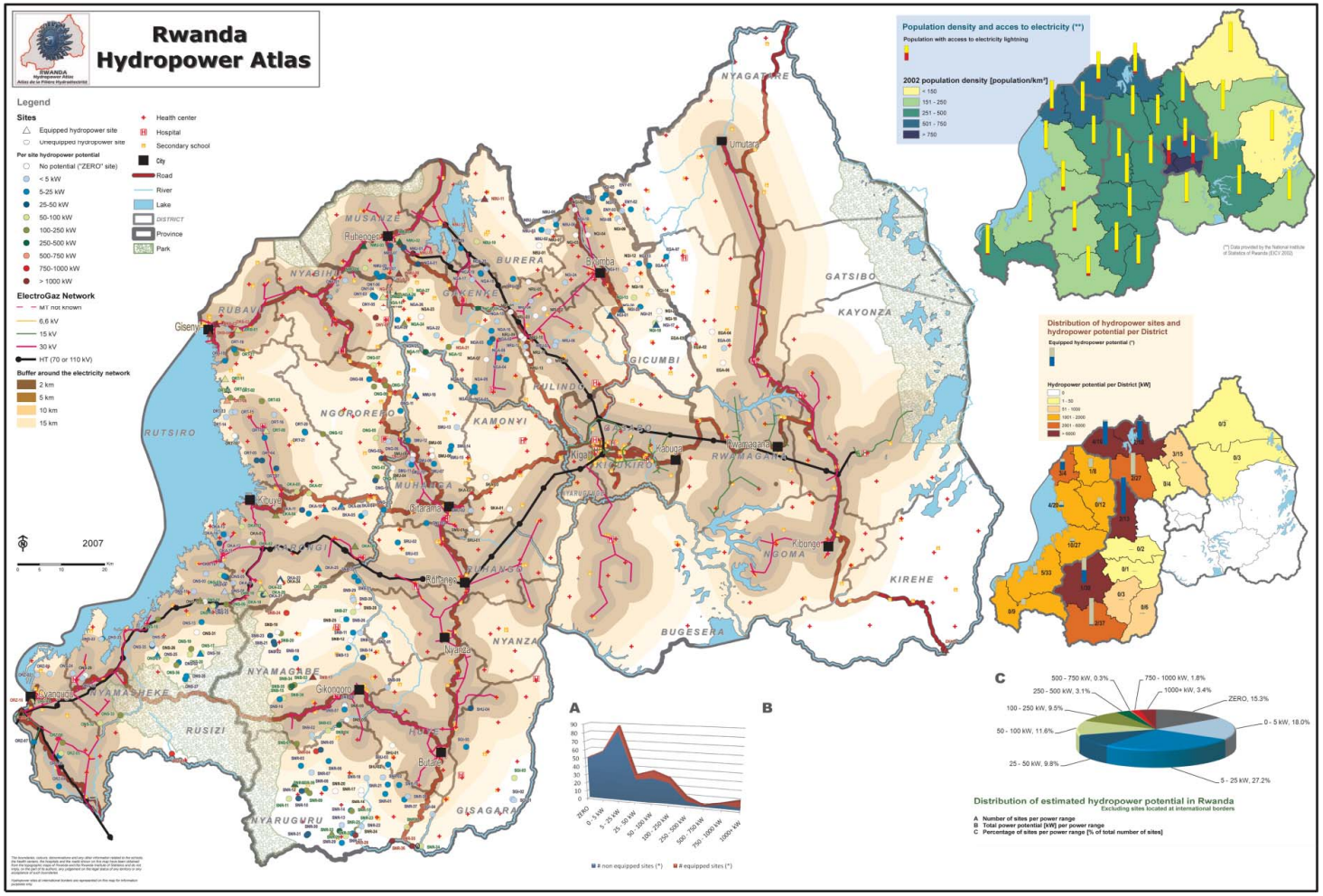
Wind Energy Potential in Africa



Source (L): Huld T., Šúri M., Dunlop E., Albuisson M, Wald L (2005). Integration of HelioClim-1 database into PVGIS to estimate solar electricity potential in Africa. Proceedings from 20th European Photovoltaic Solar Energy Conference and Exhibition, 6-10 June 2005, Barcelona, Spain, http://re.jrc.ec.europa.eu/pvgis/.

Source (R): Archer, Cristina L. and Mark Z. Jacobson. Evaluation of Global Wind Power. Journal of Geophysical Research, Vol. 110, D12110, doi:10.1029/2004JD005462, 2005

Hydropower Atlas of Rwanda



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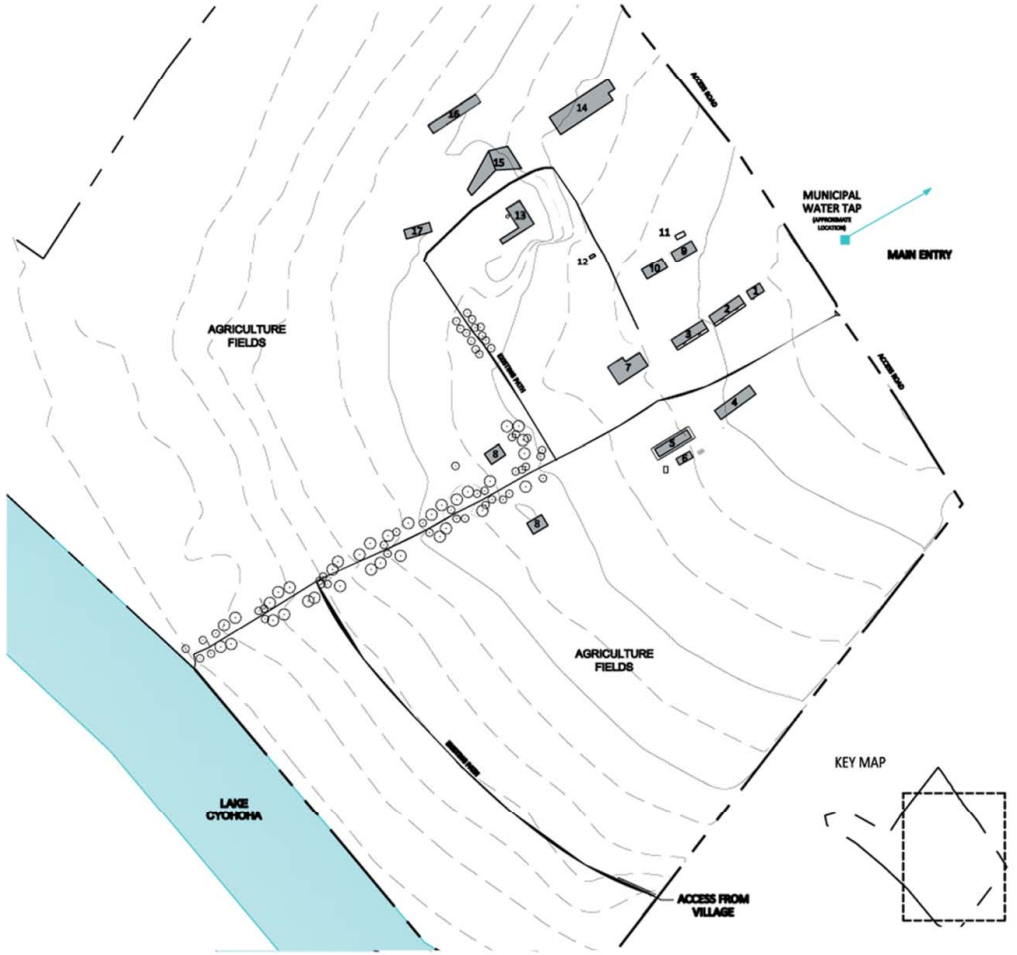
AKILAH INSTITUTE – PHASE I DESIGN

Campus Renovation - Site Plan



BUILDING LEGEND

1-3	CLASSROOMS
4	KITCHEN
5	ADMINSTRATION
6	STORAGE
7	OUTDOOR CLASSROOM
8	STAFF HOUSING
9-10	GIRLS' DORMITORIES
11	SHOWERS
12	PIT LATRINES
13	GENERATOR BUILDING
14	BOYS' DORMITORY
15-17	AGRICULTURAL STRUCTURES

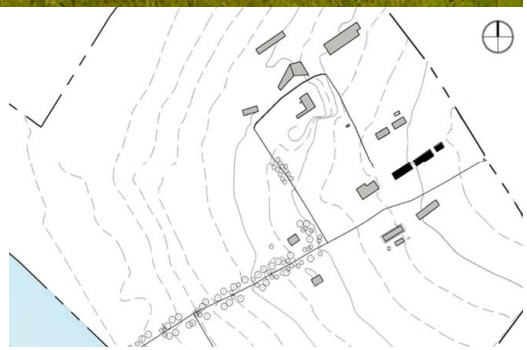
EXISTING CAMPUS AREA CALCULATIONS

BOYS' DORMITORY *	m^2
TOTAL BOYS' DORM AREA	547
GIRLS' DORMITORY 1	m^2
BED AREA	82
CLOSET	5
CLOSET	5
TOTAL	93
GIRLS' DORMITORY 2	m^2
BED AREA	82
CLOSET	5
CLOSET	5
TOTAL	93
TOTAL GIRLS' DORMAREA	370
CLASSROOM 1	m^2
CLASSROOM A	61
CLASSROOM B	61
TOTAL	122
CLASSROOM 2	m^2
CLASSROOM A	61
CLASSROOM B	61
TOTAL	122
CLASSROOM 3	m^2
CLASSROOM A	51
TOTAL CLASSROOM AREA	295
OUTDOOR WORKSHOP	m^2
SPACE A	18
SPACE B	28
SPACE C	19
TOTAL WORKSHOP SPACE	65
CAFETERIA / KITCHEN	m^2
CAFETERIA	101
KITCHEN	41
STORAGE	9
TOTAL KITCHEN/CAFÉ	151
ADMINISTRATION BUILDING *	m^2
TOTAL ADMINISTRATION BUILDING	120
GENERATOR BUILDING	m^2
SPACE A	13
SPACE B	13
SPACE C	12
SPACE D	12
SPACE E	12
SPACE F	33
SPACE G	33
TOTAL GENERATOR BUILDING	128
TOTAL CAMPUS AREA	1676 m^2

* = Individual room areas within the building are not available for these buildings
NOTE: The area for the existing staff housing on campus is not available.

PHASE I DESIGN – AKILAH INSTITUTE

Campus Renovation – Existing Classrooms



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Campus Renovation – Existing Kitchen & Cafeteria

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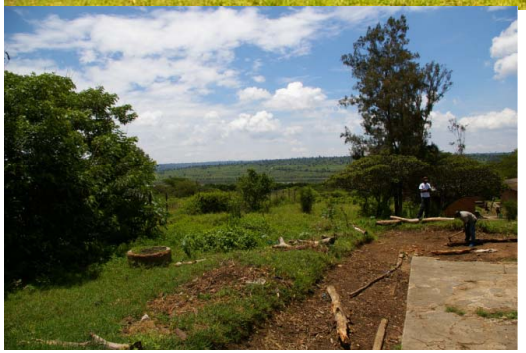
Campus Renovation – Existing Administration



PHASE I DESIGN – AKILAH INSTITUTE

Campus Renovation – Existing Dormitory

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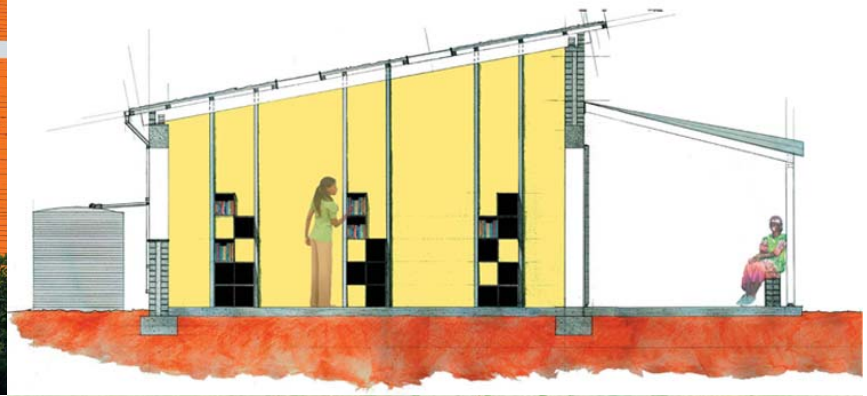
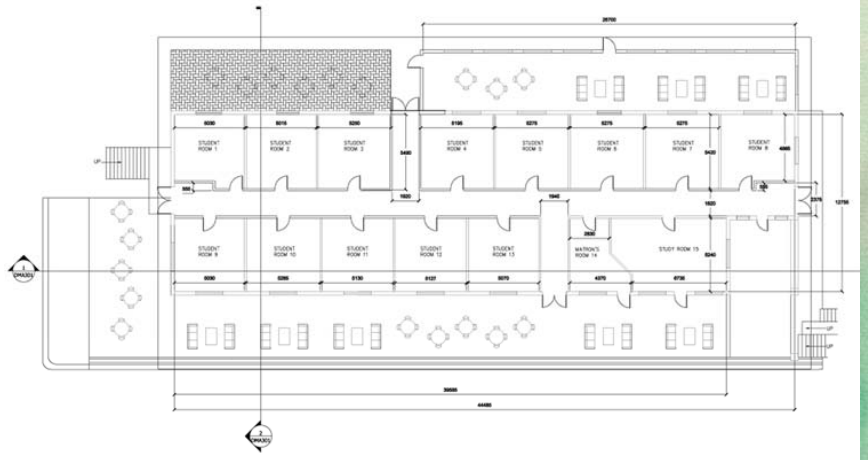
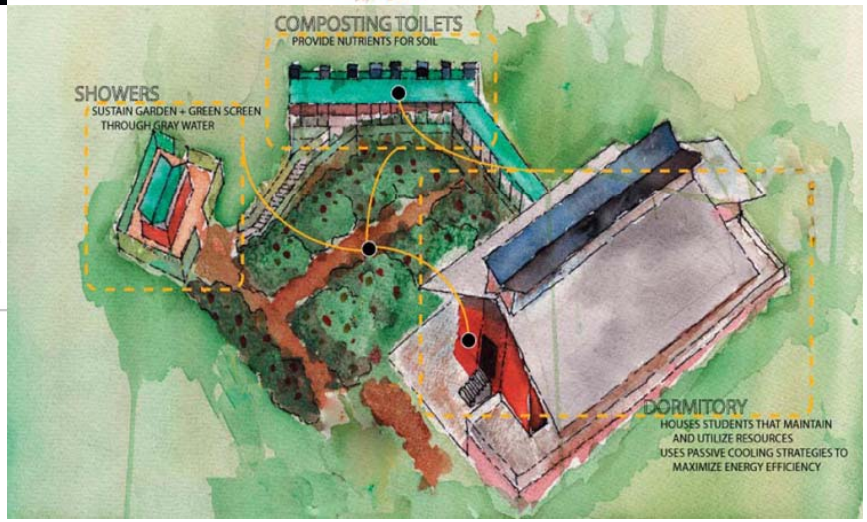
AKILAH INSTITUTE – PHASE I DESIGN

Campus Renovation – Proposed Design

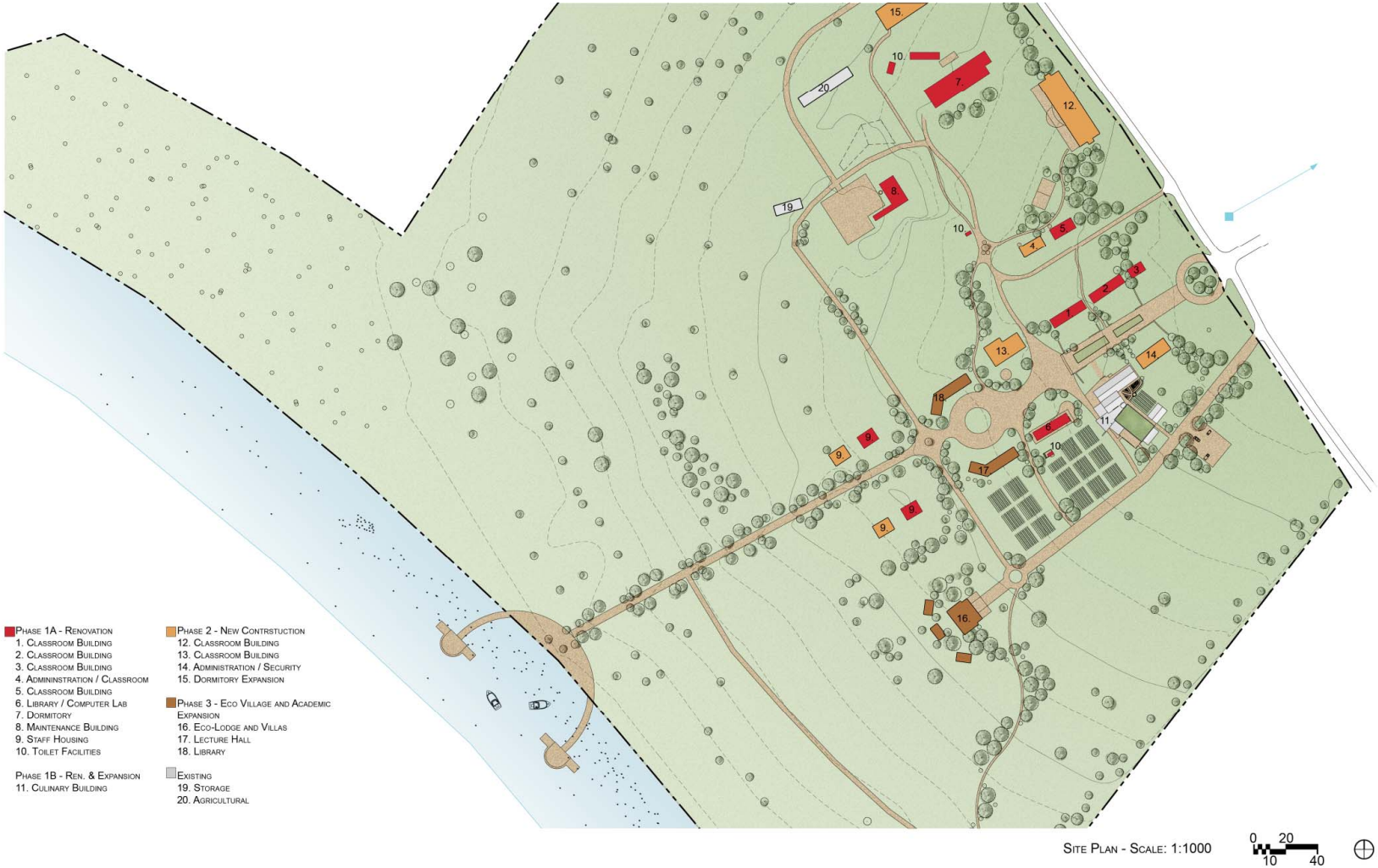






AKILAH INSTITUTE - PHASE II DESIGN

Culinary Institute - Site Plan



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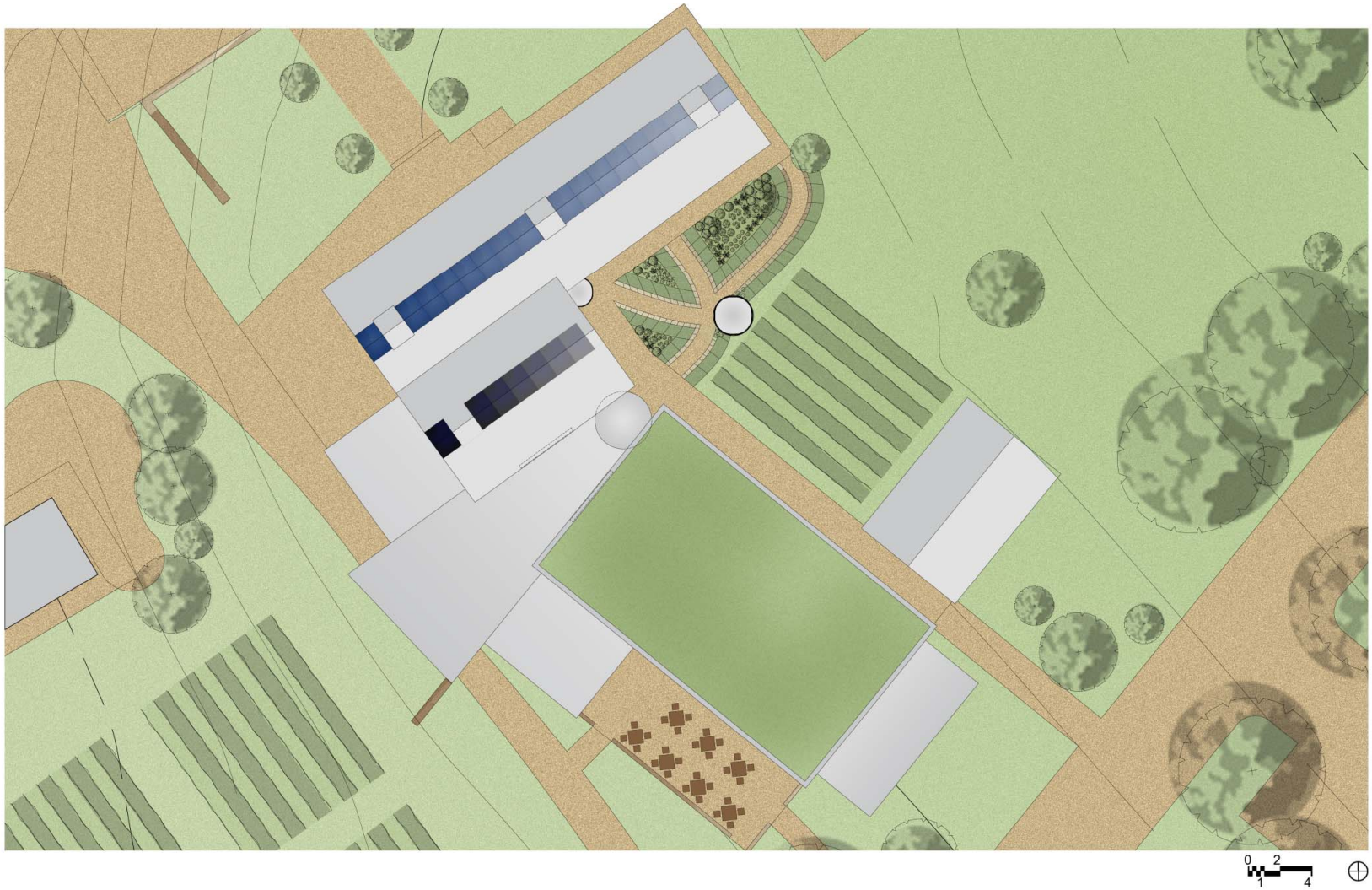
AKILAH INSTITUTE - PHASE II DESIGN

CUArch AKILAH Institute for Women

Culinary Institute - Roof Plan & Gardens



AKILAH INSTITUTE - PHASE II DESIGN

Culinary Institute - Floor Plan

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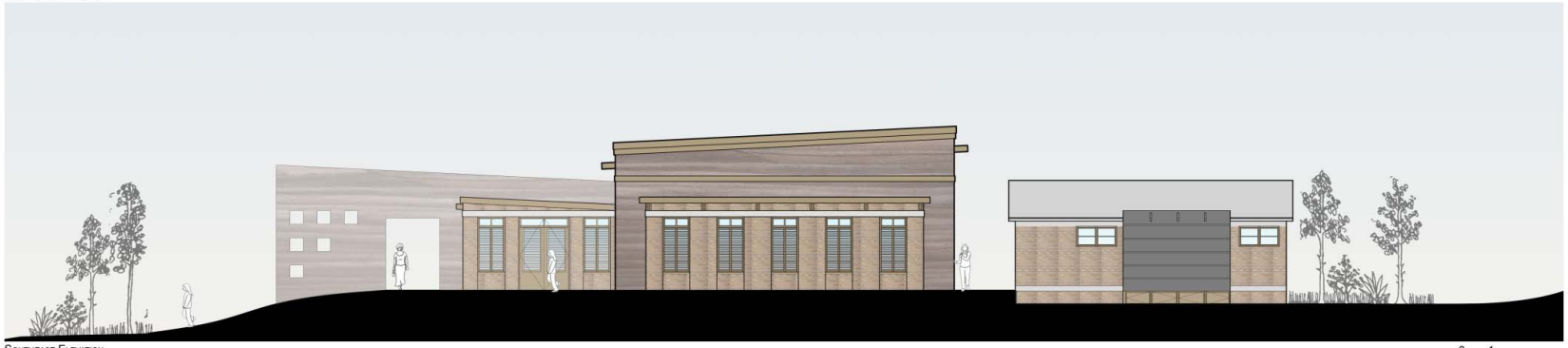
AKILAH INSTITUTE - PHASE II DESIGN

CUArch AKILAH Institute for Women

Culinary Institute - Elevations

SOUTHWEST ELEVATION



SOUTHEAST ELEVATION

ELEVATIONS - SCALE: 1:50

AKILAH INSTITUTE - PHASE II DESIGN

CUArch AKILAH Institute for Women

Culinary Institute - Elevations

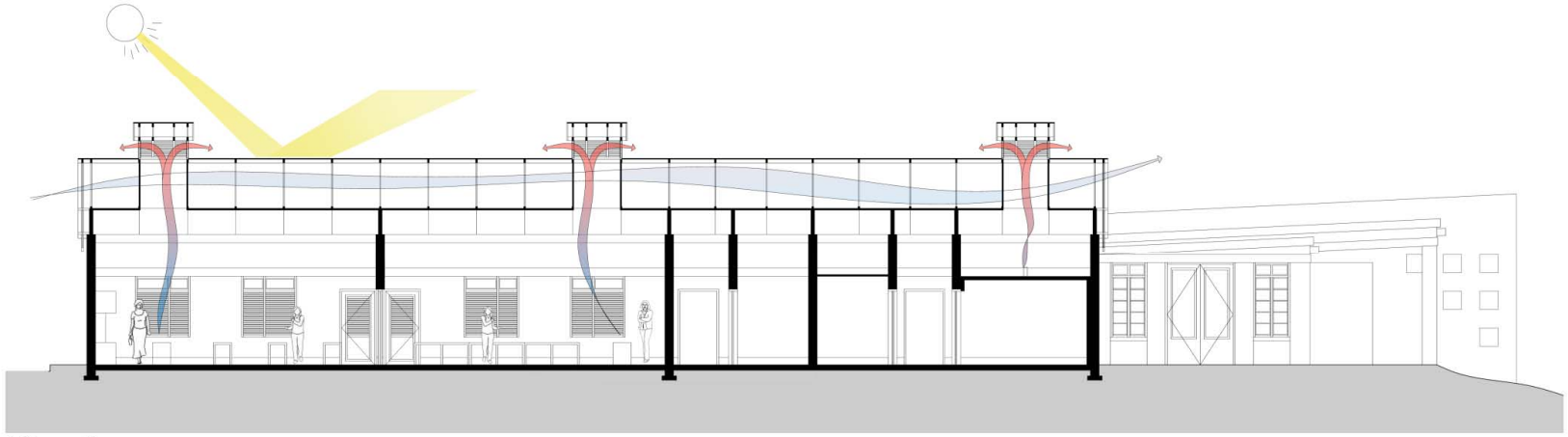
NORTHWEST ELEVATION

NORTHEAST ELEVATION

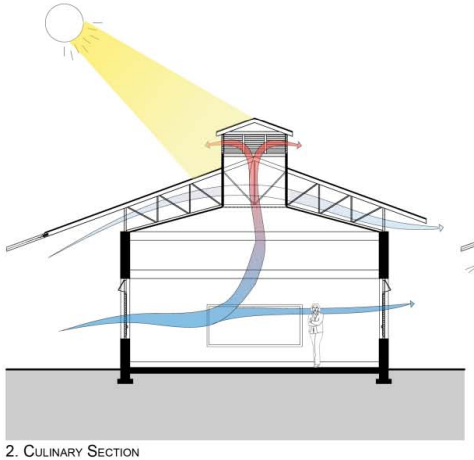
ELEVATIONS - SCALE: 1:50

CUArch AKILAH Institute for Women

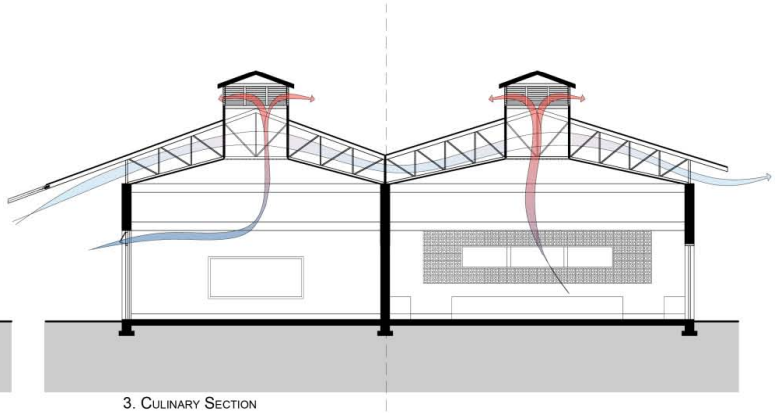
Culinary Institute - Sections



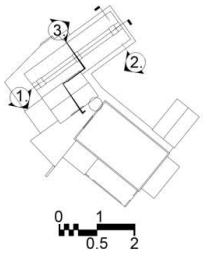
1. Culinary Sections



2. Culinary Section



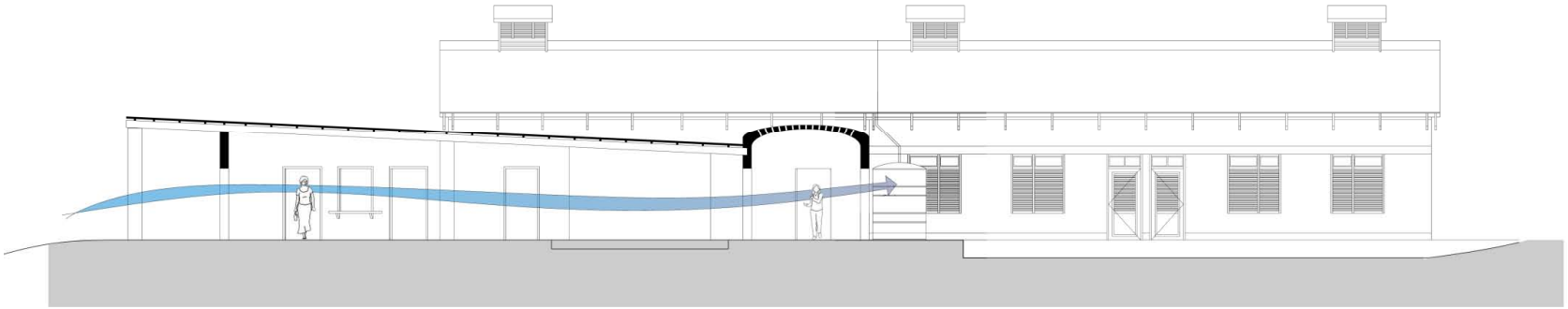
3. Culinary Section



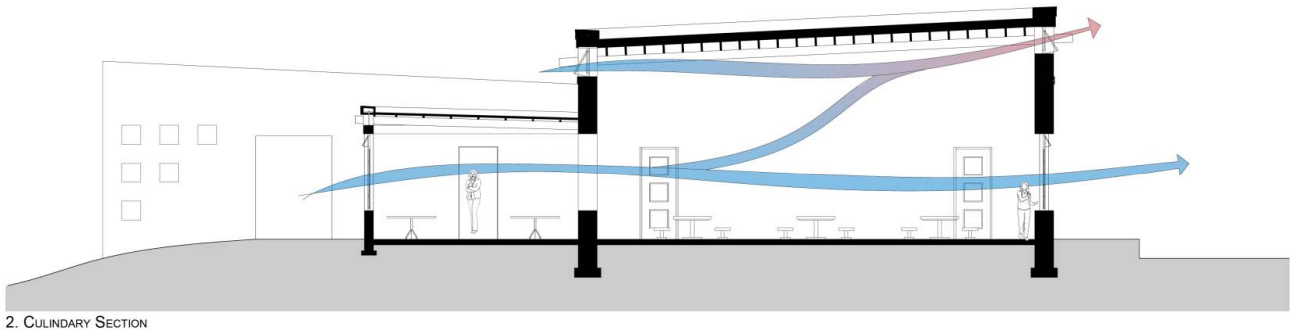
AKILAH INSTITUTE - PHASE II DESIGN

CUArch AKILAH Institute for Women

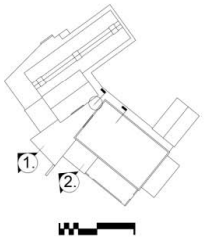
Culinary Institute - Sections



1. Culinary Sections



2. Culindary Section



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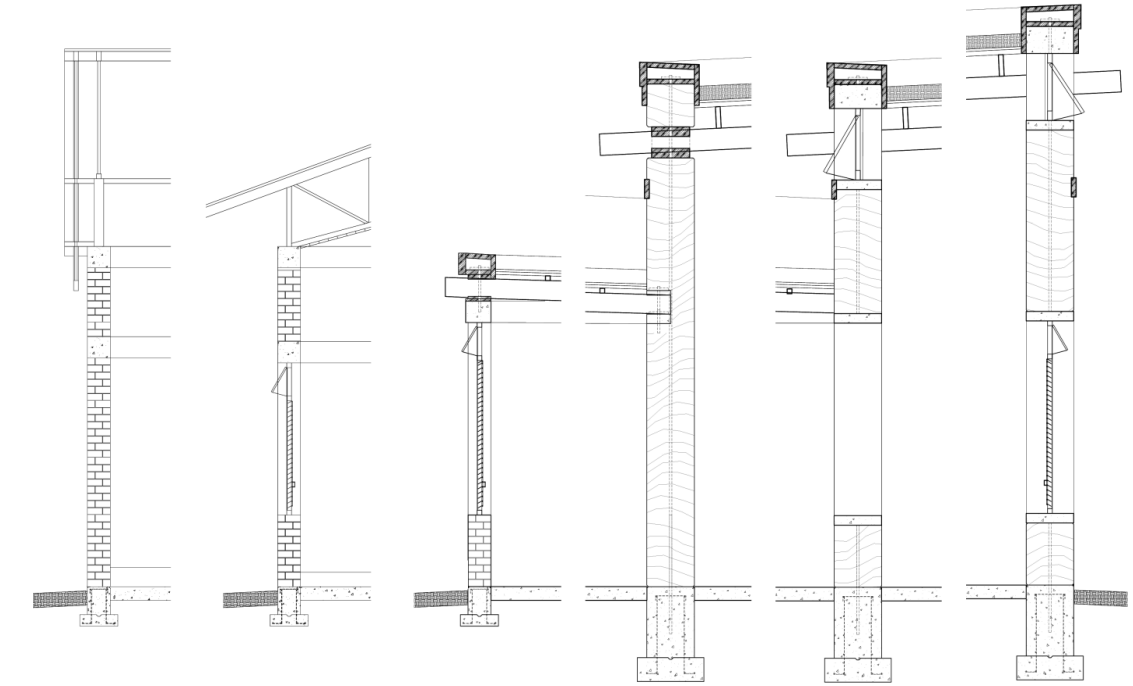
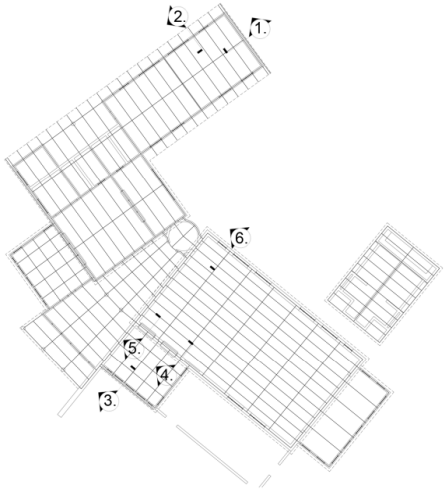
Culinary Institute - Sustainable Construction



1. Section thru Burnt Brick / CEB
2. Section thru Burnt Brick / CEB
3. Section thru CEB
4. Section thru Rammed Earth Wall
5. Section thru Rammed Earth Wall
6. Section thru Rammed Earth Wall

Sections - Scale: 1:20



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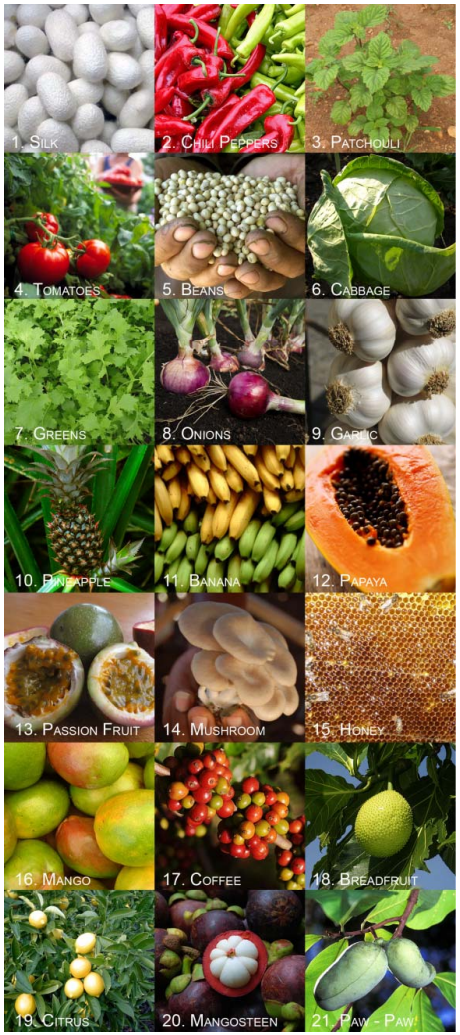
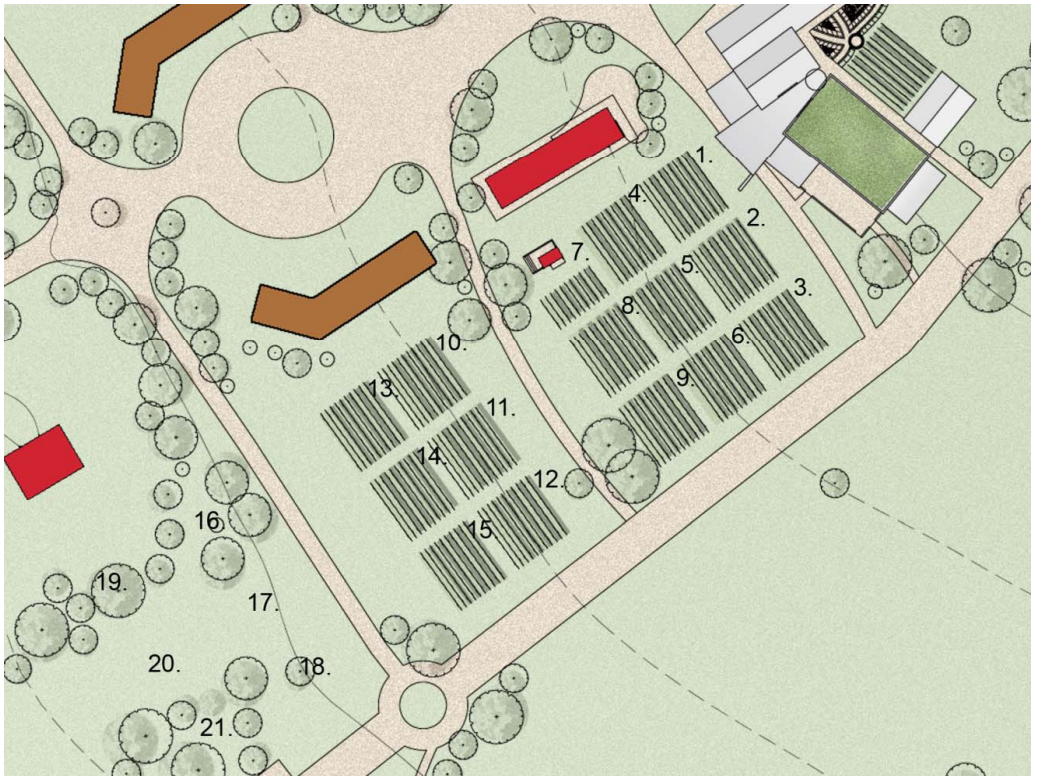
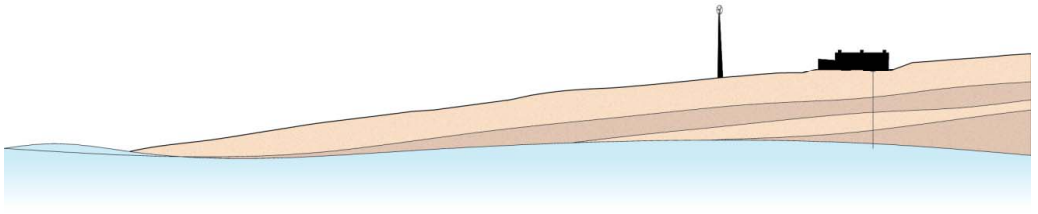
AKILAH INSTITUTE - PHASE II DESIGN

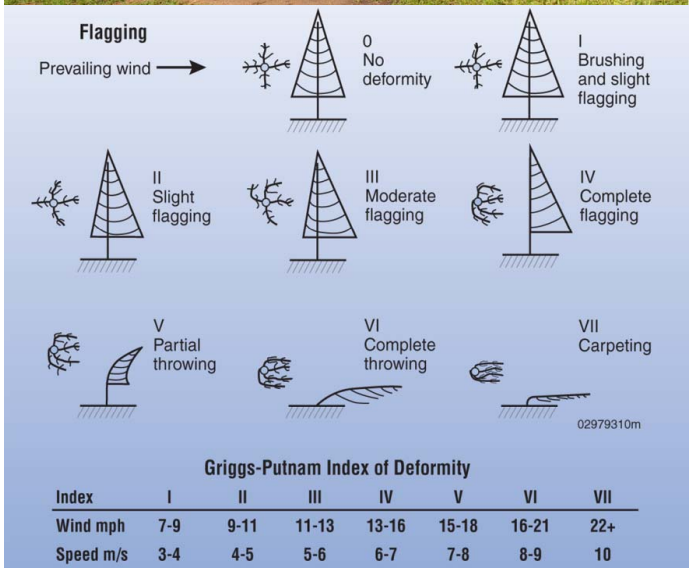
Culinary Institute - Agricultural Resources





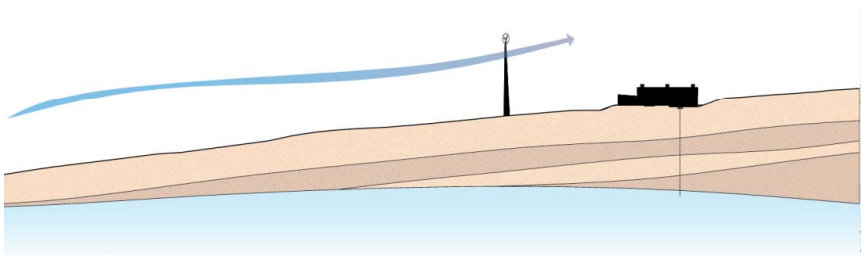


Culinary Institute - Renewable Energy Resources – Wind Studies



Griggs-Putnam Index of Deformity

Index	I	II	III	IV	V	VI	VII
Wind mph	7-9	9-11	11-13	13-16	15-18	16-21	22+
Speed m/s	3-4	4-5	5-6	6-7	7-8	8-9	10



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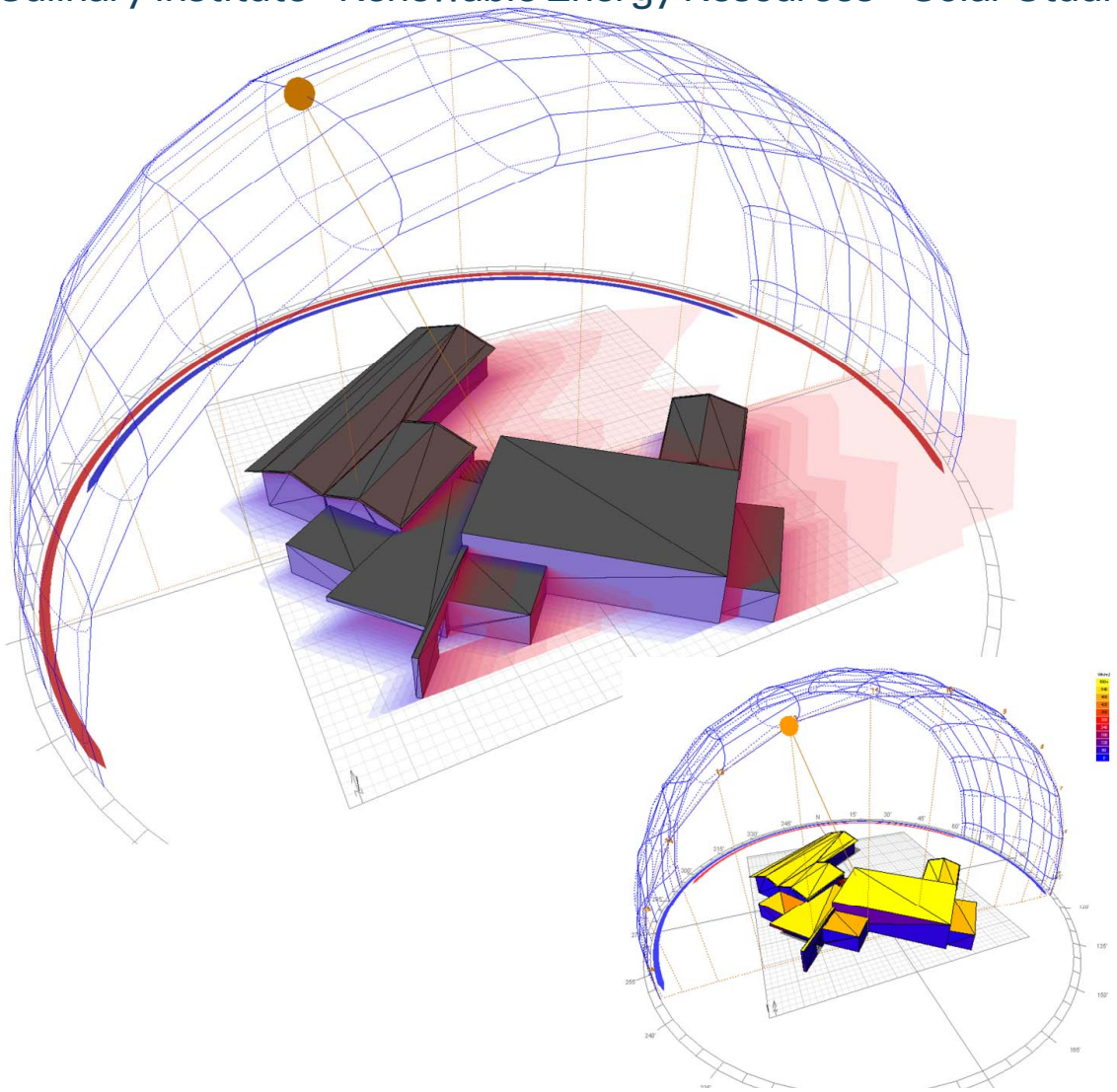

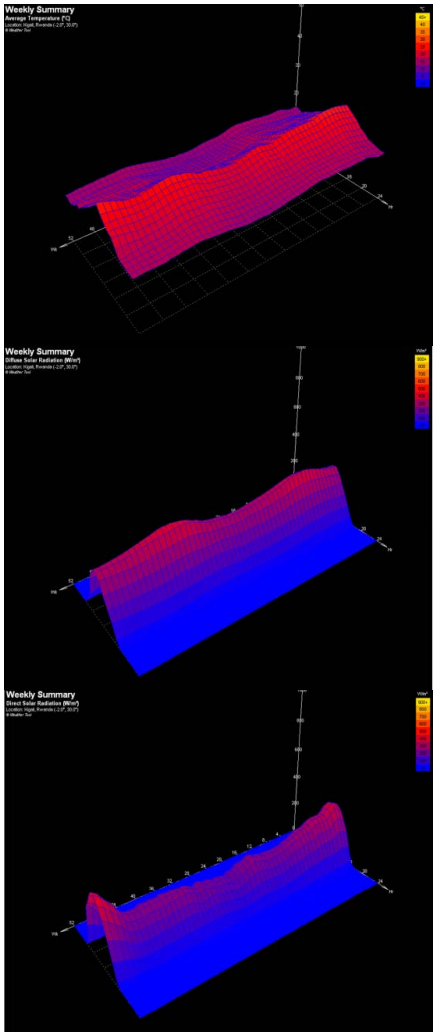

Proceedings of the 17th Symposium for
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ACKNOWLEDGMENTS

The work was partially funded by the Catholic University of America and HOK, Inc. The authors would like to thank Christopher Grech and Raj Barr of Catholic University, James Patterson and Bilal Siddiqi at Oxford University, Saroj Siegler, Vrunda Vaghela, Michelle Bove, Joe Fuentes, all the volunteers at Architecture for Humanity-DC Chapter, and Elizabeth Dearborn Davis of Akilah Institute for their support and guidance.